CLAIMS

1. A method for producing a crystalline film by melting and resolidifying a film comprising the steps of:

preparing a film having a specific region obtained either by (A) a step of forming a film in which a "specific region" and an "region continuous to a periphery of the specific region and different in thickness from the specific region" co-exist, or by (B) a step of irradiating a film with an elecrtromagnetic wave or particles having a mass in mutually different conditions in a specific region and in a peripheral region thereof,

melting at least a part of the film and resolidifying the film.

2. The method according to claim 1, wherein the step (A) includes a step of forming an irregularity on a surface of the film.

3. The method according to claim 1, wherein the step (A) includes a step of forming an irregularity on a surface of a substrate on which the film is provided.

4. The method according to claim 1, wherein the step (A) is a step of forming a film in which the specific region has a thickness larger than in the peripheral region thereof.

5. The method according to claim 1, wherein, at a maximum melting state of the film in the melting-resolidification process, a single crystal grain or single crystalline cluster remains unmelted in the specific region while the peripheral region thereof is completely melted.

6. The method according to claim 5, wherein a ratio of a dimension to a thickness of the specific region is larger, when a crystal growth of the single crystal grain or the single crystalline cluster existing in the specific region executes a crystal growth in a resolidification step, than a ratio of a growth velocity in a planar direction to a growth velocity in a direction of film thickness in the specific region.

7. The method according to claim 5, wherein a ratio of a dimension to a thickness of the specific region is, when a crystal growth of the single crystal grain or the single crystalline cluster existing in the specific region executes a crystal growth in a resolidification step, within such a range that a growth front in a direction of film thickness reaches a surface of the film before a growth front in a planar direction of the film reaches a periphery of the specific region.

8. The method according to claim 5, wherein a ratio of a dimension of the specific region to a

thickness difference between the specific region and the periphery region is larger, when a crystal growth of the single crystal grain or single crystalline cluster existing in the specific region executes a crystal growth in a resolidification step, than a ratio of a growth velocity in a planar direction to a growth velocity in a direction of film thickness in the specific region.

9. The method according to claim 5, wherein a ratio of a dimension of the specific region to a thickness difference between the specific region and the periphery region is larger, when a crystal growth of the single crystal grain or the single crystalline cluster existing in the specific region executes a crystal growth in a resolidification step, within such a range that a growth front in a direction of film thickness reaches a surface of the film before a growth front in a planar direction of the film reaches a periphery of the specific region.

10. The method according to claim 1, wherein, in the step (B), the electromagnetic wave or particles having a mass are irradiated under a condition not melting the film.

11. The method according to claim 1, wherein, in the step (B), an irradiating condition of the electromagnetic wave is different for the specific region and the peripheral region thereof in any of an

irradiation energy density, an irradiation time, a profile in tile of a power density, a spectral intensity, a coherence and a polarization degree.

12. The method according to claim 11, wherein the electromagnetic wave in the specific region has an irradiation energy density larger than an irradiation energy density in the peripheral region.

13. The method according to claim 12, wherein only the specific region is irradiated with the electromagnetic wave.

14. The method according to claim 11, wherein an irradiation of the electromagnetic wave is executed under a temperature increase of the film.

15. The method according to claim 1, wherein, in the step (B), an irradiating condition of the particles is different for the specific region and the peripheral region thereof in any of a kind, a state and an irradiation amount of the particles.

16. The method according to claim 1, wherein, in a step of melting and resolidifying at least a part of a film subjected to the step (B), a crystal grain or a crystalline cluster of a desired number is grown in the specific region.

17. The method according to claim 16, wherein the crystal grain or the crystalline cluster is a crystal grain or a crystalline cluster existing in the specific region at a maximum melting state of the

film.

18. The method according to claim 16, wherein an irradiation of an electromagnetic wave or particles having a mass under different conditions inside and outside the specific region causes a difference in a critical energy for completely melting the film.

19. The method according to claim 18, wherein a critical energy in the specific region is larger than a critical energy in the peripheral region thereof.

20. The method according to claim 19, wherein an energy charged into the film in a melting-resolidification process is smaller than a critical energy of the specific region and is larger than a critical energy of the peripheral region thereof.

21. The method according to claim 17, wherein an irradiation of an electromagnetic wave or particles having a mass under different conditions inside and outside the specific region causes a difference in a macroscopic melting point.

22. The method according to claim 21, wherein a macroscopic melting point in the specific region is larger than a macroscopic melting point in the peripheral region thereof.

23. The method according to claim 17, wherein an irradiation of an electromagnetic wave or particles having a mass under different conditions

inside and outside the specific region causes a difference in a size distribution of concentration of crystal grains or of crystalline clusters.

24. The method according to claim 23, wherein a crystal grain or of a crystalline cluster concentration in the specific region is larger than a crystal grain or a crystalline cluster concentration in the peripheral region thereof.

25. The method according to claim 23, wherein an average value of a size distribution of concentration of crystal grains or of crystalline clusters in the a specific region is larger than an average value of a size distribution of concentration of crystal grains or crystalline clusters in the peripheral region thereof.

26. The method according to claim 17, wherein an irradiation of an electromagnetic wave or particles having a mass under different conditions inside and outside the specific region causes a difference in a height of a nucleation free energy barrier in a solid-phase crystallization.

27. The method according to claim 26, wherein a nucleation free energy barrier in a solid-phase crystallization in the specific region is lower than a nucleation free energy barrier in a solid-phase crystallization in the peripheral region thereof.

28. The method according to claim 16, wherein

the crystal grain or the crystalline cluster is a crystal grain or a crystalline cluster formed by a nucleation from a molten phase in a resolidification step after the melting of the film.

29. The method according to claim 17, wherein an irradiation of an electromagnetic wave or particles having a mass under different conditions inside and outside the specific region causes a difference in a height of nucleation free energy barrier in a solidification from a molten phase.

30. The method according to claim 29, wherein a local irradiation of particles having a mass causes a difference in any of an element composition ratio, an impurity content, a surface adsorbed substance and an interfacial state with a substrate in contact with the film, of the film, inside and outside the specific region.

31. The method according to claim 1, wherein a spatial position of at least a part of crystal grains having a continuous crystalline structure in the crystalline film is determined by a spatial position of the specific region.

32. An element utilizing a crystalline film obtained by a producing method according to claim 1, wherein a spatial position of at least a part of crystal grains having a continuous crystalline structure in the crystalline film is determined by a

spatial position of the specific region, and a crystal grain having the determined spatial position is utilized as an active area.

33. The element according to claim 32, wherein an active area is formed inside a single crystal grain of the crystalline film.

34. A circuit including a plurality of the element according to claim 32, and a wiring between the elements.

35. The method according to claim 1, characterized in that, by defining a melting point of a bulk crystal as Tc and a supercooling degree causing a spontaneous nucleation from a molten phase as ΔTc in a melting-resolidification process of the film, the specific regions are provided with such an interval that a portion positioned between the specific regions of the predetermined interval reaches a temperature equal to or higher than $Tc - \Delta Tc$ at a time when an unsolidified region reaches a supercooling degree of ΔTc at the resolidification of the film.

36. The method according to claim 35, wherein the specific regions are provided with such an interval that a portion where a region, in the vicinity of a growth front of a crystal grain growing from a specific region and having a higher temperature than in a periphery, overlaps with a

region, in the vicinity of a growth front of a crystal grain growing from another specific region and having a higher temperature than in a periphery, has a temperature equal to or higher than Tc - ΔTc.

37. The method according to claim 36, wherein the specific regions are provided with such an interval that growth fronts of crystal grains growing from two specific regions mutually contact before a time when a portion where a high-temperature region, in the vicinity of a growth front of a crystal grain growing from a specific region, overlaps with a high-temperature region, in the vicinity of a growth front of a crystal grain growing from another specific region, reaches a temperature equal to or lower than Tc - ΔTc.

38. The method according to claim 1, characterized, in a melting-resolidification process of a film, in melting the film with plural heating means and resolidifying the film.

39. The method according to claim 38, wherein at least one of the plural heating means is heating means having a constant heating intensity without a change with time, in a melting process of the film.

40. The method according to claim 39, wherein the heating means having a constant heating intensity is a heat conduction from a substrate, an irradiation with a continuously oscillated laser light, or a

current-supply heating of the film.

41. The method according to claim 38, wherein at least one of the plural heating means is heating means having a heating intensity changing with time, in a melting process of the film.

42. The method according to claim 41, wherein the heating means having a heating intensity changing with time is a pulsed laser irradiating the film with two pulses of different intensities with a time difference.

43. The method according to claim 38, wherein the plural heating means includes heating means having a constant heating intensity without a change with time in a melting process of the film, and heating means having a heating intensity changing with time in a melting process of the film.

44. The method according to claim 38, wherein the plural heating means includes heating means which heats the film to a temperature not exceeding a melting point, and heating means for heating the temperature-elevated film thereby melting the film.

45. The method according to claim 1, characterized in including a step of giving a heat not changing with time to the film thereby heating the film to a temperature not exceeding a melting point, a step of giving a heat changing with time thereby heating and melting the temperature-elevated

film, and a step of resolidifying the film.

46. A method for producing a crystalline film by growing crystal grains from plural specific regions provided in a starting film in a melting-resolidification process of the film, characterized in that, by defining a melting point of a bulk crystal as Tc and a supercooling degree causing a spontaneous nucleation from a molten phase as ΔTc in a melting-resolidification process of the film, the specific regions are provided with such an interval that a portion positioned between the specific regions of the predetermined interval reaches a temperature equal to or higher than Tc - ΔTc at a time when an unsolidified region reaches a supercooling degree of ΔTc at the resolidification of the film.

47. A method for producing a crystalline film characterized in melting a film, in which regions of mutually different states co-exist in continuation, by plural heating means and resolidifying the film.

48. A method for producing a crystalline film characterized in including a step of giving a heat not changing with time to a film, in which regions of mutually different states co-exist in continuation, thereby heating the film to a temperature not exceeding a melting point, a step of giving a heat changing with time thereby heating and melting the

temperature-elevated film, and a step of resolidifying the film.